RESULTS AND DISCUSSION

IV- RESULTS AND DISCUSSION

1. FIRST EXPERIMENT: Effect of sulphur soil application, nitrogen, phosphorus and potassium fertilizers on plant vegetative growth, bulbs yield and quality as well as storagebility of onion bulbs:

1.1. Effect on vegetative growth characteristics:

Data illustrated in Table (3) show the effect of sulphur soil addition and nitrogen, phosphorus as well as potassium fertilizers level on vegetative growth aspects of onion plant expressed plant length, bulb and blades length, number of tubular blades per plant, fresh weight of plant, blades and bulbs weight.

With regard to the effect of sulphur, it is evident from such data that sulphur application at different used levels enhanced all the studied growth parameters and increased their values than those of control one. In this respect, the medium and the highest used rates (300 and 200 kg/fed.) reflected the highest values of all growth aspects without significant effects in between for most studied characters. In addition such enhancing effect did not reach the level of significancy in case of whole plant, blade and bulb length as well as number of tubular blades per plant during the first growing season and number of tubular blades in the second one. Obtained results are supported by those of Khalaf and Taha (1988) working on garlic, Jana and Kabir (1990) and Abd El-Gawad and Mahmoud (1993) all working on onion who reported that sulphur application increased plant growth of such bulb crops.

With concern to the effect of N, P_2O_5 and K_2O fertilizers on the onion plant vegetative growth, obtained results show that irrespective of plant blade and bulb length as well as number of leaves per plant during the first season and number of leaves during the second season which was not significantly affected, all the studied vegetative plant growth aspects of onion plant were significant and continously increased with increasing rates of fertilizers up-to the highest used one, *i.e.* 135 kg N + 90 kg P_2O_5 + 72 Kg K_2O/fed. The improving effects of increasing rate of N, P_2O_5 and K_2O fertilizers are in agreement with those reported by Madan and Sandhu (1983), Hanna Alla *et al.* (1991), Vachhani and Patel (1996), Rizk,Fatma (1997) and Oukal (1999).

Respecting the effect of interaction between sulphur soil application and N, P_2O_5 and K_2O –fertilizers rate on vegetative plant growth parameters, data presented in Table (3) show that increasing both sulphur addition and fertilizer levels increased all the studied growth parameters during both seasons of study. In this respect, the highest values in all studied growth characters were connected with the highest used levels of the studied factors, *i.e.* 200 or 300 kg/fed. sulphur in combination with 90 + 60 + 48 or 135 + 90 + 72 kg NPK, respectively.

It could be concluded that, under such conditions, the highest used sulphur rates (200 or 300 kg/fed.) combined with the highest applied NPK rates 90 kg N + 60 Kg P_2O_5 + 48 kg K_2O or (135 Kg N + 90 kg P_2O_5 + 72 kg K_2O/fed.) are recommended to obtain the most vigorous growth of onion plants.

Table (3): Effect of sulphur soil application rate, N, P and K-fertilizers levels and their interaction on some growth parameters of onion plants.

Treatment		Season 1995-1996							Season 1996-1997						
Sulphur (kg/fed.)	$N+P_2O_5+K_2O$ (kg/fed.)	Plant length (cm)	Leaf length (cm)	Bulb length (cm)	Plant weight (g)	Leaves weight /plant (g)	Bulb weight (g)	No. of leaves/ plant	Plant length (cm)	Leaf length (cm)	Bulb length (cm)	Plant weight (g)	Leaves weight /plant (g)	Bulb weight (g)	No. of leaves/ plant
0	---	70.8	66.6	4.2	102.7	76.1	26.1	9.1	82.6	77.8	4.8	170.5	105.2	65.3	10.3
100	---	72.1	67.6	4.5	113.8	83.5	30.3	9.2	84.7	80.4	4.3	171.5	107.4	64.1	10.6
200	---	72.3	67.8	4.5	116.1	85.0	31.0	9.5	86.4	81.8	4.6	175.1	109.7	65.4	10.7
300	---	72.5	67.9	4.6	118.1	85.3	33.3	9.5	87.0	82.0	5.0	178.3	113.0	65.3	10.8
L.S.D. at 0.05		n.s.	n.s.	n.s.	2.5	2.0	1.0	n.s.	1.0	0.8	0.1	5.8	3.6	0.7	n.s.
---	45+30+24	69.8	65.4	4.4	103.3	73.9	27.4	9.0	82.2	77.5	4.7	166.3	104.5	61.8	10.5
---	90+60+48	71.5	67.0	4.5	111.3	77.9	29.9	9.3	85.6	81.0	4.6	173.4	107.5	65.9	10.6
---	135+90+72	74.5	69.9	4.6	123.8	90.5	33.4	9.7	87.8	83.0	4.8	181.9	114.4	67.5	10.8
L.S.D. at 0.05		n.s.	n.s.	n.s.	1.6	1.4	0.8	n.s.	1.1	0.6	0.1	2.6	2.6	0.4	n.s.
0	45+30+24	69.7	65.6	4.1	98.8	74.3	24.5	8.7	78.1	73.1	5.0	158.7	96.0	62.7	10.2
	90+60+48	70.1	65.8	4.3	104.0	76.4	27.6	9.1	84.7	79.9	4.8	172.1	101.1	71.0	10.2
	135+90+72	72.6	68.3	4.3	105.2	78.9	26.3	9.4	85.1	80.5	4.6	180.8	118.5	62.3	10.7
100	45+30+24	67.6	63.3	4.3	99.6	79.6	20.0	8.8	84.0	79.8	4.2	160.5	102.4	58.1	10.3
	90+60+48	71.5	66.9	4.6	114.6	85.3	29.3	9.4	84.9	80.7	4.2	170.7	106.5	64.2	10.6
	135+90+72	77.2	72.5	4.7	127.3	85.6	41.7	9.4	85.3	80.7	4.6	183.1	113.4	69.7	10.8
200	45+30+24	70.7	66.1	4.6	106.2	76.1	30.1	9.1	82.0	77.7	4.3	169.4	109.0	60.4	10.5
	90+60+48	72.5	68.1	4.4	116.8	86.3	30.5	9.4	84.7	80.2	4.5	173.7	109.5	64.2	10.7
	135+90+72	73.7	69.2	4.5	125.3	92.8	32.5	10.0	92.4	87.5	4.9	182.1	110.5	71.6	10.8
300	45+30+24	71.1	66.7	4.4	108.6	73.6	35.0	9.3	84.6	79.5	5.1	176.4	110.6	65.8	10.8
	90+60+48	71.9	67.2	4.7	109.8	77.8	32.0	9.4	88.1	83.2	4.9	177.2	113.3	63.9	10.8
	135+90+72	74.4	69.7	4.7	137.4	104.5	32.9	9.8	88.3	83.2	5.1	181.4	115.1	66.3	10.9
L.S.D. at 0.05		5.2	4.8	n.s.	3.2	2.8	1.6	n.s.	2.2	1.2	0.2	5.2	5.3	0.7	n.s.

1.2. Onion bulbs yield and its components:

Data indicated in Table (4) show the effect of sulphur addition, NPK fertilizers and their interaction on total yield and its components. Obtained data reveal that, addition of sulphur at its different used rates increased the total bulbs yield, marketable yield and average bulb weight of produced bulbs. These results are true during both seasons of growth. In this regard, the highest produced total and marketable bulbs yields as well as average bulb weight were produced as a result of using the highest two rates of sulphur (200 or 300 kg/fed.). Such results may be due to the role of sulphur in plant nutrition and its effect on soil pH and consequently on the availability of nutrients necessary for plant growth as shown by data presented in Table (3) which reflected on yield and its components. Similar results were reported by Jitendra and Dhnkar (1989), Jana and Kabir (1990) and Abd El-Gawad and Mahmoud (1993) who found that higher bulbs yield and average weight of bulb were obtained with sulphur at higher used rates. Moreover, Khalaf and Taha (1988) on garlic reported that, sulphur was very beneficial for total bulbs yield. Meantime, Rajas *et al.* (1993) found that the highest yield (78.11 ton/ha) was obtained with 80 kg sulphur/ha. However, Singh and Pandey (1995) and Anez *et al.* (1996) found that bulbs yield was not significantly affected by sulphur soil application rates.

Regarding the effect of N, P_2O_5 and K_2O fertilizers rate on total and marketable bulbs yield as well as average bulb weight, the same data in Table (4) reveal that, all the studied yield parameters expressed as total and marketable bulbs yield as well as average fresh weight of bulb were significantly increased with increasing fertilizers levels. In

this concept, the highest total bulbs yield and its components were obtained in case of using the highest used rate of fertilizers (135 Kg N + 90 kg P_2O_5 + 72 kg K_2O/fed.). Obtained results are connected with the effect of such macro-nutrients on vegetative growth Table (3). Such results are confirmed with those reported by Koltunoy (1984) who found that using NPK at 60 + 60 + 120 kg/ha., respectively, gave the best yield of garlic bulbs. Similar results were reported also by Saimbhi *et al.* (1987), Katwale and Saraf (1994) and Rizk, Fatma (1997) who reported that the highest bulbs yield of onion was obtained with the highest N, P_2O_5 and K_2O fertilizer rates. On the other hand, Laughlin (1989), Tendaj (1991) and Anez *et al.* (1996) reported that with various combinations of N, P_2O_5 and K_2O fertilizers, bulbs yield was not significantly affected.

Concerning the interaction effect between sulphur and fertilizers level on total and marketable bulbs yield as well as average weight of bulb, the same date presented in Table (4) show that all the studied characters mentioned hereabove were significantly affected. In this respect, the combination between the highest used levels of each of N, P_2O_5 and K_2O-fertilizer as well as sulphur soil application resulted in the highest values of studied yield characters.

Hence, it is generally advisable that application of 200 or 300 kg/fed. of sulphur at time of soil preparation and fertilizing onion plants with 135 Kg N + 90 kg P_2O_5 + 72 K_2O/fed. leads to the highest total and marketable bulbs yield as well as average fresh weight of bulb.

Respecting the effect of sulphur soil application on the percentage of each of doubles and bolters of onion bulbs, data

presented in Table (4) show that the highest used rate of sulphur (300 kg/fed.) significantly decreased the values of the percentage of both of studied characters. The improving effect of sulphur on the quality of onion bulbs expressed as percentage of doubles, and bolters, which were decreased.

Regarding the effect of nitrogen, phosphorus and potassium fertilizers level on percentages of doubling and boltering, data presented in Table (4) show that increasing the level of such fertilizers significantly improved all the studied characters. In this regard, bulbs of the best quality were produced from plots treated with the highest used level of N, P_2O_5 and K_2O-fertilizers [135 kg N + 90 kg P_2O_5 + 72 K_2O/fed.] in both seasons of this work. Such improving effect of the highest used level of N, P_2O_5 and K_2O-fertilizers on onion quality was also found by Saimbhi *et al.* (1987) working on onion who reported that all three nutrients at the highest used rate gave bulbs of the best quality. Similar findings were also reported by Jitendra and Dhanker (1989) on onion who found that high N and K_2O levels reduced boltering. However, Khalil *et al.* (1988b) and Farag and Koriem (1990) on onion showed that increasing nitrogen level was accompunied with an increase in double bulbs yield. In this regard, each of El-Kafoury (1986). Leughlin (1989), Abu-Grab and Fahmy (1991), Badr *et al.* (1995) and Oukal (1999) reported that N, P_2O_5 and K_2O-fertilizers had no effect on bulb quality of onion.

With regard to the combined effect of the different rates of soil applied sulphur and those of nitrogen, phosphorus and potassium fertilizers on the percentage of each of doubling and boltering of bulbs, the same data presented in Table (4) show that such studied

Table (4): Effect of sulphur soil application rate, N, P and K-fertilizers level and their interaction on total bulbs yield and its components.

Treatment		Season 1995-1996					Season 1996-1997				
Sulphur (kg/fed.)	$N+P_2O_5+K_2O$ (kg/fed.)	Total bulbs yield (ton/fed.)	Marketable bulbs yield (ton/fed.)	Average weight of bulb (g)	% of No. of double bulbs	% of No. of bolters bulbs	Total bulbs yield (ton/fed.)	Marketable bulbs yield (ton/fed.)	Average weight of bulb (g)	% of No. of double bulbs	% of No. of bolters bulbs
0	---	17.994	16.469	164.3	4.82	4.87	18.966	18.292	146.3	1.84	0.88
100	---	18.791	17.040	164.6	2.61	4.11	19.132	18.702	147.3	1.38	0.81
200	---	19.927	18.574	178.8	2.56	3.85	19.429	18.411	158.5	0.28	0.61
300	---	21.270	20.041	197.0	2.40	2.41	19.731	18.954	160.9	0.01	0.52
L.S.D. at 0.05		0.4	0.4	2.3	0.3	0.4	0.6	n.s.	21.4	0.1	0.2
---	45+30+24	18.529	17.151	165.4	2.43	5.05	18.03	17.38	139.2	0.40	1.30
---	90+60+48	19.263	17.614	172.7	3.13	3.68	19.571	18.907	156.1	0.83	0.81
---	135+90+72	20.694	19.329	190.4	3.73	2.71	20.406	19.525	164.4	1.42	0.01
L.S.D. at 0.05		0.4	0.4	2.5	0.2	0.2	0.5	0.5	12.2	0.1	0.1
0	45+30+24	17.371	16.317	160.6	3.15	5.89	17.816	17.468	132.4	1.57	1.86
	90+60+48	18.161	16.369	166.1	5.41	4.40	18.858	18.716	151.6	1.92	0.76
	135+90+72	18.451	16.721	166.2	5.90	4.32	20.225	19.050	154.9	2.04	0.01
100	45+30+24	17.828	16.117	156.6	2.14	4.73	18.226	17.772	131.7	0.01	1.50
	90+60+48	18.858	17.045	161.2	2.25	4.10	18.970	18.902	147.0	1.31	0.91
	135+90+72	19.686	17.959	175.9	3.43	3.51	20.201	19.431	163.1	2.81	0.01
200	45+30+24	18.486	16.954	163.1	2.32	4.94	17.317	16.005	145.2	0.01	1.03
	90+60+48	19.151	17.628	176.4	2.51	5.52	20.176	19.213	163.3	0.01	0.80
	135+90+72	22.143	21.141	197.0	2.84	2.08	20.793	19.657	167.0	0.83	0.01
300	45+30+24	20.431	19.216	181.4	2.11	4.64	18.653	18.105	147.6	0.01	0.81
	90+60+48	20.883	19.413	187.1	2.36	1.68	20.138	18.796	162.6	0.01	0.75
	135+90+72	22.497	21.495	222.4	2.73	0.91	20.403	19.962	172.6	0.01	0.01
L.S.D. at 0.05		0.8	0.8	4.9	0.5	0.50	1.0	1.0	24.5	0.2	0.3

characters were clearly affected and improved with increasing the applied amount of both factors of study.

Hence, application of 300 kg sulphur per fed. before transplanting of onion and addition of the highest used levels of N, P_2O_5 and K_2O-fertilizers [135 kg N + 90 kg P_2O_5 + 72 kg K_2O/fed.] may be recommended for obtaining onion bulbs of the best quality expressed as lower percentage of double and bolters bulbs.

1.3. Onion bulbs strorageability parameters:

Data presented in Table (5) show the effect of different rates of sulphur soil application and nitrogen, phosphorus and potassium fertilizers on storageability parameters, *i.e.* percentage of sprouting, rotting, total weight loss and marketable bulbs of onion. Such data reveal that application of the highest used level of sulphur (300 kg/fed.) significantly increased the storageability of onion bulbs when stored under room conditions. Obtained results may be due to the role of sulphur as a constituent of pungency substances which is positively connected with the storageability of bulbs. Such favourable effects of sulphur application on the storageability of onion bulbs are in agreement with the results obtained by Pawar and Patil (1989) and Randle (1992) who found that foliar application of different rates of sulphur affected the pungency of bulbs which in turn affected bulbs storageability. Such correlation suggested that sulphur is differentially partitioned into flavour and non-flavour compounds in the bulbs of onions.

Respecting the effect of nitrogen, phosphorus and potassium fertilizers level on storageability studied parameters, such as percentage of sprouting, rotting, total weight loss and marketable

bulbs, data persented in Table (5) show that increased level of N, P_2O_5 and K_2O-fertilizers significantly increased the percentages of hereabove characters excpet the percentage of marketable bulbs which was decreased in this respect. On the other hand, the lowest applied level of N, P_2O_5 and K_2O-fertilizers [45 kg N, 30 kg P_2O_5 and 24 K_2O/fed.] significantly improved the onion bulbs storageability through decreasing the percentages of sprouting, rotting and total weight loss of bulbs and consequently increased the percentages of the marketable bulbs of onion at the end of the storage period. In this respect, Moustafa (1979) and Midan and Sandhu (1983) showed that high nitrogen rates have an adverse effect on bulbs storageability of onion. Meantime, Koltunoy (1984) found that using NPK at 60 : 60 : 120 kg/ha. respectively was suitable for long-term storage of garlic. Moreover, Khalil *et al.* (1988b) reported that percentage of weight loss, due to discarding rotted and sprouted bulbs during storage period, also showed that increasing N-fertilizer increased weight loss in stored bulbs as assessed at all tested intervals. They reported that results may be explained partially on the basis that increasing nitrogen level increased moisture contents in the produced bulbs, thereby may increased weight loss by means of water evaporation and also the highest respiration process and consequently led to a reduction in dry matter. Moreover, Jitendra and Dhankar (1991) on onion found that using 80 kg N + 100 kg K_2O/ha. had the best effect on storage quality. Similarly, Wright (1993) found that stored onion bulbs were affected by rates of nitrogen fertilizer where high nitrogen fertilizer level, which produced higher total weight loss of onion bulbs, resulted in more rotted bulbs than those received no nitrogen fertilizer which

produced less total weight loss of onion bulbs. Meantime, Singh *et al.* (1994) and Pandey and Pandey (1994) mentioned that as nitrogen fertilizer application rate increased, postharvest storage losses due to sprouting, rotting, moisture loss and weight loss increased also. They reported that the storage quality of bulbs decreased with increased rates of N-fertilizers. With concern to P-fertilizers, Laughlin (1989) on onion reported that P_2O_5 fertilizer level increased storage rots. However, Abu-Grab and Fahmy (1991) found that the application of different levels of P_2O_5 showed no effect on this character of onion. With respect to applied level of potassium, studies of Fattahalla *et al.* (1992) on garlic crop, found that the weight loss percentage and sprouting were decreased with increasing K_2O-fertilizer level. At the end of storage period, sound cloves percentage was increased. This was due to that shrinkage discoloration and soft cloves percentage were decreased with increasing K_2O-fertilizer rate. However, Dyachenko (1981) indicated that onion bulbs showed best keeping quality when they were produced from plants grown without fertilization. Moreover, Bottcher and Kolbe (1975) on onion cleared that the keeping quality depended more on factors other than K_2O and P_2O_5 fertilizers level including annual variation in growing and storage conditions of bulbs. With regard to the combination of NPK fertilization, El-Kafoury (1986) found that N, P_2O_5 and K_2O application in a single from or in various combinations had no effect on total loss weight. However, El-Shabrawy *et al.* (1987) on garlic found that percentage of bulb infection during storage increased with an increase in ammonium nitrate level from zero up to 1200 kg/fed. during the growing season. However, percentage of infection

Table (5): Effect of sulphur soil application rate, N, P and K-fertilizers level and their interaction on storageability parameters of onion bulbs.

Treatment		Season 1995-1996				Season 1996-1997			
Sulphur (kg/fed.)	$N+P_2O_5+K_2O$ (kg/fed.)	Sprouting percentage as No.	Rotting percentage as No.	Total loss weight percentage	Marketable bulbs percentage as weight	Sprouting percentage as No.	Rotting percentage as No.	Total loss weight percentage	Marketable bulbs percentage as weight
0	---	1.31	18.21	19.89	70.1	0.66	3.22	18.60	79.7
100	---	1.02	15.49	19.58	72.9	0.20	2.64	16.17	80.1
200	---	0.78	15.30	19.44	73.8	0.18	2.63	14.38	81.8
300	---	0.68	14.01	17.04	75.1	0.01	2.16	14.17	82.9
L.S.D. at 0.05		0.03	0.6	0.9	2.8	0.1	0.3	0.3	1.1
---	45+30+24	0.66	13.01	17.31	76.3	0.01	1.27	13.73	83.0
---	90+60+48	0.88	14.29	18.76	72.5	0.15	2.35	14.90	81.9
---	135+90+72	1.31	19.96	20.90	70.1	0.64	4.36	18.87	78.5
L.S.D. at 0.05		0.02	0.4	0.7	1.8	0.1	0.8	0.3	2.0
0	45+30+24	0.85	16.58	19.33	74.8	0.01	2.58	16.13	84.2
	90+60+48	0.85	17.94	19.69	68.1	0.31	2.96	16.84	81.7
	135+90+72	2.22	20.12	20.66	67.3	1.66	4.11	22.84	73.1
100	45+30+24	0.77	12.37	17.64	74.7	0.01	1.62	13.79	81.6
	90+60+48	1.06	14.10	18.43	72.5	0.01	2.95	14.99	80.3
	135+90+72	1.24	20.00	22.67	71.4	0.60	3.34	19.72	78.4
200	45+30+24	0.50	11.84	17.19	77.8	0.01	0.31	12.09	82.6
	90+60+48	0.86	12.69	20.47	73.7	0.26	1.60	13.48	82.5
	135+90+72	0.99	21.35	20.66	69.8	0.29	5.98	17.60	80.4
300	45+30+24	0.50	11.23	15.06	77.7	0.01	0.58	12.91	83.7
	90+60+48	0.75	12.43	16.45	75.6	0.01	1.89	14.29	82.9
	135+90+72	0.79	18.37	19.60	72.0	0.01	4.01	15.32	82.1
L.S.D. at 0.05		4.1	0.9	1.3	n.s.	1.0	1.6	0.6	4.0

decreased to 50% when superphosphate fertilization was increased from zero up to 800 kg/fed. Similarly, infection percentage decreased to 33% with an increase in potassium sulphate level from zero up to 200 kg/fed. In this respect, similar findings were reported by Oukel (1999) who indicated that the best treatment which showed the lowest mean value of weight loss percentage was that of the control one followed by application of relatively high level of NPK, *i.e.* 120 kg N + 60 kg P_2O_5 + 45 kg K_2O/fed.

Concerning the effect of the interaction between sulphur soil application and nitrogen, phosphorus and potassium fertilizers level on studied storageability parameters of onion bulbs, *i.e.* percentages of sprouting, rotting, total weight loss and marketable bulbs, data presented in Table (5) show that the highest used rates of sulphur (300 kg/fed.) in combination with the lowest used level of N, P_2O_5 and K_2O fertilizers (45 kg N, 30 kg P_2O_5 and 24 kg K_2O/fed.) resulted in the lowest values of sprouted, rotted and total weight loss bulbs percentage and the highest marketable sound bulbs during storage and consequently good storageability of onion bulbs.

1.4. Effect on keeping quality of bulbs during the storage period:

Data presented in Tables (6 & 7) show the effect of sulpur soil application and N, P_2O_5 and K_2O-fertilizers as well as their interaction on the keeping quality of the produced onion bulbs from the treated during the five months of storage.

With respect to the effect of sulphur soil application on the keeping quality of onion bulbs which was expressed as percentages of sprouting, rotting, total weight loss and marketable bulbs during the storage period of five months extended from the middle of July up to

middle of December. Such results show that values of the studied bulb characters, *i.e.* percentage of sprouting, rotting and total weight loss were gradually decreased with the prolongation of storage period where the highest values of rotting and total weight loss were reported on July, August and September compared with October and December months. Moreover, application of sulphur at 300 kg/fed. reduced the percentage of such characters. With respect to the sprouting characters the same data show that December month had the highest values compared with other months of storage. In this regard, using 300 kg S/fed. led to the lowest sprouting percentage during the storage period compared with other treatments in both growth seasons. In this respect, Randle (1992) working on onion, reported that significant differences were founded between different cvs. as affected by sulphur fertilizer level which affected in turn the bulb sulphur content. He reported also that the correlation between bulb sulphur content and its pungency was poor, suggesting that sulphur is differently partitioned into flavour and non-flavour compounds in the bulbs of onion.

Respecting the effect of N, P_2O_5 and K_2O fertilizers levels on the keeping quality of onion bulbs, expressed as the same aforementioned characters, during five months of storage, the same data presented in Tables (6 & 7) show that the relatively lower level of N, P_2O_5 and K_2O-fertilizers resulted in the lowest percentage of total weight loss of bulbs, sprouting and rotting percentage during the storage period. Moreover, the same treatment was connected with the highest percentage marketable bulbs during the storage period. Moreover, the highest values of such characters were obtained during July, August and September compared with November and December.

However, sprouting character had the highest values in Nov. and Dec. months. Meanwhile, the highest values were obtained with the highest used level, *i.e.* 135 kg N, 90 kg P_2O_5 and 72 K_2O/fed. similar, results were reported by Bottcher and Kolbe (1975) on onion who cleared that the keeping quality depended more on factors other than K_2O and P_2O_5 fertilizers level including annual variation in growing and storage conditions of bulbs. Moreover, El-Kafoury (1986) found that N, P_2O_5 and K_2O application in a single form or in various combinations had no effect on total weight loss. Moreover, Oukal (1999) also indicated that the best treatment which showed the lowest mean value of weight loss percentage was that of the control one followed by application of relatively high level of NPK, *i.e.* 120 kg N + 60 kg P_2O_5 and 45 kg K_2O/fed. Similarly, Singh *et al.* (1996) on onion found that loss resulting from rotting and physiological weight loss was high in May when temperature was high while monthly loss was lower in June-August and then significantly increased being the highest in Oct. under Indian conditions.

Concerning the effect of interaction between sulphur soil addition and NPK-fertilizers levels on keeping quality of onion bulbs, during the storage period, the same data in Tables (6 & 7) show that the best effects on onion bulbs keeping quality were resulted from the combination between the highest used level of sulphur (300 kg/fed.) combined with the lowest used rates of N, P_2O_5 and K_2O-fertilizers, *i.e.* 45 kg N, 30 kg P_2O_5 and 24 kg K_2O/fed.

Table (6): Effect of sulphur soil application rate, N, P and K-fertilizers level and their interaction on keeping quality of onion bulbs during storage for five months in 1995-1996 season.

Treatments		1st month				2nd month				3rd month				4th month				5th month			
Sulphur (kg/fed.)	$N+P_2O_5+K_2O$ (kg/fed.)	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %
0	---	0	9.16	4.81	91.78	0	3.02	2.52	86.89	0	3.44	2.71	78.11	0.53	1. 0	1.46	72.66	0.56	0.86	1.08	70.11
100	---	0	8.99	4.72	92.22	0	2.60	2.09	87.22	0	2.07	1.95	81.78	0.44	1.89	1.32	75.78	0.30	0.52	1.02	72.89
200	---	0	8.96	4.65	92.33	0	2.52	1.70	87.67	0	2.04	1.65	82.11	0.19	1.73	1.11	76.11	0.28	0.41	0.90	73.89
300	---	0	7.84	4.49	92.44	0	1.79	1.60	88.78	0	1.48	1.44	82.78	0	1.39	1.05	77.44	0.19	0.28	0.45	75.33
---	45+30+24	0	7.84	3.96	93.50	0	1.81	1.52	90.09	0	1.43	1.01	83.99	0.09	1.06	0.97	78.67	0	0.11	0.16	76.25
---	90+60+48	0	8.80	4.77	92.00	0	2.41	1.97	87.25	0	1.94	1.74	81.09	0.21	1.51	1.31	75.17	0.29	0.47	0.70	72.42
---	135+90+72	0	10.37	5.27	91.09	0	3.23	2.45	85.39	0	2.27	3.06	78.50	0.50	2.62	1.43	72.67	0.59	0.96	1.52	70.50
0	45+30+24	0	7.94	3.31	93.33	0	2.71	2.08	91.67	0	2.01	1.42	84.33	0.37	1.03	1.08	77.33	0	0.44	0.54	74.67
	90+60+48	0	9.57	5.20	91.00	0	2.89	2.25	85.00	0	3.28	2.36	76.67	0.38	1.48	1.59	71.33	0.45	0.82	0.76	68.00
	135+90+72	0	9.98	5.93	91.00	0	2.45	3.24	84.00	0	5.03	4.35	73.33	0.84	3.18	1.72	69.33	1.14	1.31	1.94	67.67
100	45+30+24	0	6.23	4.24	94.67	0	2.44	1.72	88.33	0	1.53	0.73	82.33	0	1.17	1.03	77.33	0	0	0.82	74.67
	90+60+48	0	9.08	4.68	92.33	0	2.45	1.85	87.67	0	1.72	1.17	81.67	0.45	1.92	1.40	75.33	0.35	0.70	0.90	72.33
	135+90+72	0	11.64	5.24	89.67	0	2.90	2.72	85.67	0	3.49	3.05	81.33	0.78	2.59	1.51	74.67	0.46	0.87	1.34	71.67
200	45+30+24	0	7.92	4.03	92.67	0	1.09	0.97	88.67	0	0.75	0.88	85.33	0	0.78	0.96	79.67	0	0	0.08	78.00
	90+60+48	0	8.23	4.64	92.33	0	2.43	2.04	87.33	0	0.76	2.15	82.67	0	1.30	1.18	76.00	0.35	0.37	1.15	73.67
	135+90+72	0	10.74	5.27	92.00	0	4.04	2.08	87.00	0	2.92	2.82	78.33	0.37	3.12	1.19	72.67	0.39	0.84	1.44	70.00
300	45+30+24	0	6.08	4.25	93.33	0	0.98	1.30	91.67	0	1.45	1.01	84.00	0	1.24	0.82	80.33	0	0	0	77.67
	90+60+48	0	8.31	4.58	92.33	0	1.85	1.75	89.00	0	2.01	1.30	83.33	0	1.35	1.05	78.00	0	0	0	75.67
	135+90+72	0	9.13	4.63	91.67	0	2.53	1.75	85.67	0	2.68	2.01	81.00	0	1.59	1.29	74.00	0.38	0.83	1.36	72.67

T.W.L. = Total weight loss.

Table (7): Effect of sulphur soil application rate, N, P and K-fertilizers level and their interaction on keeping quality of onion bulbs during storage for five months in 1996-1997 season.

Treatments		1st month				2nd month				3rd month				4th month				5th month			
Sulphur (kg/fed.)	$N+P_2O_5+K_2O$ (kg/fed.)	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %
0	---	0	1.03	2.64	91.00	0	1.69	2.70	86.89	0	0.78	1.27	84.56	0.49	0.56	0.77	81.44	0.15	0.09	0.50	79.78
100	---	0	0.82	2.15	92.33	0	0.82	1.91	87.78	0	0.75	1.07	84.67	0.14	0.32	0.56	81.89	0.14	0.00	0.11	80.10
200	---	0	0.77	1.62	92.78	0	0.74	1.46	88.44	0	0.49	0.67	85.00	0.00	0.23	0.31	82.55	0.00	0.00	0.00	81.55
300	---	0	0.56	1.53	92.78	0	0.71	1.16	90.22	0	0.19	0.29	87.22	0.00	0.01	0.22	84.11	0.00	0.00	0.00	82.78
---	45+30+24	0	0.14	0.97	93.33	0	0.43	1.33	89.22	0	0.08	0.07	86.67	0.00	0.08	0.08	84.42	0.00	0.00	0.00	82.75
---	90+60+48	0	0.66	2.03	92.25	0	0.84	1.63	88.33	0	0.49	0.67	85.58	0.07	0.21	0.32	83.25	0.00	0.00	0.16	81.23
---	135+90+72	0	0.67	2.96	91.08	0	1.60	2.86	86.75	0	1.09	0.67	83.83	0.48	0.62	0.99	79.83	0.21	0.07	0.30	79.08
0	45+30+24	0	0.28	1.41	93.00	0	0.87	1.42	90.00	0	0.00	0.17	85.00	0.00	0.30	0.21	86.33	0.00	0.00	0.00	81.00
	90+60+48	0	1.27	2.77	91.33	0	1.55	2.67	87.33	0	1.15	1.16	84.67	0.30	0.56	0.27	83.00	0.00	0.00	0.61	79.00
	135+90+72	0	1.54	3.74	88.67	0	2.65	4.02	83.33	0	1.17	1.88	84.00	1.65	0.81	1.82	75.00	0.59	0.27	0.89	79.00
100	45+30+24	0	0.00	0.95	92.33	0	0.55	0.97	89.00	0	0.30	0.03	88.33	0.00	0.00	0.14	83.00	0.00	0.00	0.00	84.00
	90+60+48	0	0.25	2.52	92.33	0	0.65	1.29	88.00	0	0.54	0.51	85.00	0.00	0.27	0.72	82.00	0.00	0.00	0.00	81.67
	135+90+72	0	2.20	2.99	92.33	0	1.25	3.45	86.33	0	1.40	1.98	80.67	0.28	0.69	0.82	80.67	0.26	0.00	0.32	74.67
200	45+30+24	0	0.26	1.26	93.67	0	0.00	1.24	89.00	0	0.00	0.07	85.33	0.00	0.00	0.00	83.67	0.00	0.00	0.00	82.00
	90+60+48	0	0.87	1.64	92.67	0	0.54	1.44	88.33	0	0.28	0.62	85.33	0.00	0.00	0.19	83.67	0.00	0.00	0.00	80.33
	135+90+72	0	1.16	1.97	92.00	0	1.68	1.71	88.00	0	1.21	1.31	84.33	0.00	0.68	0.75	80.33	0.00	0.00	0.00	83.67
300	45+30+24	0	0	0.24	94.33	0	0.30	0.10	91.67	0	0.00	0.00	88.00	0.00	0.00	0.00	84.67	0.00	0.00	0.00	82.33
	90+60+48	0	0.27	1.21	92.67	0	0.62	1.12	89.67	0	0.00	0.37	87.33	0.00	0.00	0.11	84.33	0.00	0.00	0.00	82.33
	135+90+72	0	1.41	3.15	91.33	0	1.23	2.27	89.33	0	0.56	0.50	88.00	0.00	0.30	0.56	83.33	0.00	0.00	0.00	82.33

T. W .L. = Total weight loss.

2. SECOND EXPERIMENT: Effect of onion planting date and cultivar on plant vegetative growth, bulbs yield, quality and storageability:

2.1. Effect on plant vegetative growth characters:

Data presented in Tables (8 & 9) show the effect of transplanting date and cultivars on the different measured vegetative growth parameters, *i.e.*, length of blade, bulb and whole plant, weight of blades, bulb and whole plant, number of leaves per plant as well as percentage of total soluble solids in bulb. Such data show that early planting on December 5th increased most of the studied morphological characters where both blades and whole plant length and weight showed the highest values in this respect during both growing seasons compared with other planting dates (Dec. 25th and Jan. 15th). However, bulb weight, number of leaves per plant as well as percentage of T.S.S. did not behave the same. In this respect, the second (medium) planting date at Dec. 25th showed the highest values of bulb weight, but leaves number per plant and percentage of T.S.S. resulted in variable trend. Obtained results are true in both growing seasons of this study. Such results are in harmony with those of Omran and Awad (1979), Mondal *et al.* (1986a), Miccolis (1987) and Amin *et al.* (1995) working on onion. In this respect, Omran and Awad (1979) reported that early transplanting produced higher vegetative growth expressed as weight of blades, yields of salad onions, and higher number of leaves that developed before bulbing starts than in the case of later planting. However, Pandey *et al.* (1992) working on onion also found that the greatest neck thickness were obtained with the June 1st transplanting under Indian conditions. On the other hand,

Galmarini *et al.* (1995) working also on onion reported that values of leaves number were decreased with delaying transplanting date.

Respecting the effect of cultivar, the same data in Tables (8 & 9) show that Giza 20 and Composite cvs. gave higher values of vegetative growth parameters compared with Giza 6-Mohassen cv. Concerning T.S.S.% in bulbs, Giza 6M cv. showed the highest values in this respect compared with those of Giza 20 cv. and Composite cvs. The resultes showing the response of plant growth to used cultivar are in agreement with those reported by El-Shafie *et al.* (1971) working on onion where they found that the plant foliage was more vigrous in Behairy cv. [from which Giza 20 was initiated] as compared to Giza 6 Mohassen cv. Similar findings were reported by Omran and Awad (1979) working on onion where they found that Behairy onion cv. was of higher growth rate expressed as the leaves number per plant and of larger leaves compared with Giza 6 M cv. They attributed such findings to the presence of thicker cuticle, higher proportion of amino acids and total phenols in the Behairy cv., such variatal differences were also reported by Khalil *et al.* (1988a) working on onion they found that Giza 20 cv. approved to be of superior growth parameters than Giza 6-Mohassen and Shandaweel No. 1 cvs.

With regard to the effect of interaction between transplanting date and cultivars, the same data presented in Tables (8 & 9) show that Giza 20 or Composite cvs. when grown on early planting date (December 5th) produced plants of higher values of either plant length, blades length, blades weight and number of leaves per plant. However, Giza 20 cv. when planted on December 25th resulted in the highest plant and bulb weight in the first growing season. Respecting

T.S.S. % in bulbs, data in the same Tables (8 & 9) did'n show clear effect where treatments showed the highest values were not the same in both seasons of this work.

As a general conclussion, early transplanting (December 5th) of the cultivar Giza 20 produced plants of the highest growth parameters than other tested treatments.

Concerning the effect of planting date and cultivar on bulbing ratio, data presented in Tables (8 & 9) show that bulbing ratio was significantly affected by both of used planting date and cultivar in the two growing seasons in this study. With regard to planting date, the same data in Tables (8 & 9) show that the highest values of bulbing ratio [lower efficiency of bulbing ratio] in all the studied samples were obtained as a result of medium and late plantings (on December 25th and January 15th) compared with early planting (on December 5th). In this respect the highest values of bulbing ratio were found in the 3rd sample due to increased age and size of plant during this period also due to favourable climactic factors such as day length and the accumulation of carbohydrates during these periods of growth. Such effect of day length on onion plant bulbs was investigated by Lereari (1982) who found that increase in carbohydrates content in bulbs of onion plants is induced by long day conditions and the increase of carbohydrates levels can be fully and rapidly reversed by transferring the plants to short day conditions. Furthermore, the carbohydrates accumulation was obtained only where the daylength period contains a relatively high proportion of far-red light. Neither along photoperiod without far-red nor the addition of far-red light during a 10 hrs photoperiod can induce the carbohydrates accumulation.

Table (8): Effect of planting date and cultivar on some vegetative growth parameters of plant onion during 1995-1996 season.

Treatments		Bulbing ratio			Plant length (cm)	Blades length (cm)	Bulb length (cm)	Plant weight (g)	Blades weight (g)	Bulb weight (g)	Leaves No.	% T.S.S.
Plant date	Cultivar	1st sample	2nd sample	3rd sample								
December 5th	---	0.8	0.6	0.4	73.5	69.3	4.2	165.7	99.4	66.3	9.9	12.0
December 25th	---	0.6	0.5	0.3	62.1	57.9	4.4	161.0	51.4	109.6	9.1	14.3
January 15th	---	0.6	0.4	0.3	49.6	44.7	4.9	124.2	29.3	94.9	10.1	14.0
L.S.D. at 0.05		0.03	0.03	0.02	0.9	1.0	0.2	3.7	1.1	8.5	0.2	0.2
---	Giza 20	0.7	0.5	0.4	66.6	62.1	4.5	164.6	71.6	93.0	9.9	13.5
---	Giza 6 M.	0.6	0.4	0.3	56.8	52.7	4.2	130.8	43.9	86.9	9.5	13.7
---	Composite	0.7	0.5	0.3	61.8	57.0	4.8	155.7	64.6	91.1	9.8	13.7
L.S.D. at 0.05		0.03	0.02	0.02	0.6	0.6	0.1	2.4	1.4	6.0	0.2	0.1
December 5th	Giza 20	0.8	0.6	0.5	76.9	72.7	4.2	176.3	108.6	67.7	10.3	11.6
	Giza 6 M.	0.8	0.5	0.4	67.0	63.0	4.0	136.1	75.9	60.2	9.1	12.3
	Composite	0.8	0.6	0.4	76.7	72.2	4.5	184.8	113.7	71.1	10.3	12.1
December 25th	Giza 20	0.7	0.5	0.4	70.2	65.6	4.6	198.0	71.1	126.9	9.2	14.3
	Giza 6 M.	0.6	0.4	0.3	57.6	53.5	4.1	135.7	34.4	101.3	9.2	14.5
	Composite	0.6	0.5	0.3	59.0	54.5	4.5	149.6	48.8	100.8	9.1	14.1
January 15th	Giza 20	0.6	0.4	0.3	52.8	48.1	4.7	119.4	35.0	84.4	10.1	14.6
	Giza 6 M.	0.5	0.3	0.3	46.3	41.7	4.6	120.7	21.5	99.2	10.1	14.2
	Composite	0.6	0.4	0.3	49.7	44.4	5.3	132.6	31.4	101.2	10.0	13.3
L.S.D. at 0.05		0.05	n.s.	0.03	1.0	1.0	0.2	4.1	2.5	10.4	0.3	0.2

Table (9): Effect of planting date and cultivar on some vegetative growth parameters of plant onion during 1996-1997 season.

Treatments		Bulbing ratio			Plant length (cm)	Blades length (cm)	Bulb length (cm)	Plant weight (g)	Blades weight (g)	Bulb weight (g)	Leaves No.	% T.S.S.
Plant date	Cultivar	1st sample	2nd sample	3rd sample								
December 5th	---	0.8	0.6	0.4	71.4	67.0	4.4	128.8	74.9	53.9	10.1	13.6
December 25th	---	0.6	0.4	0.3	62.2	57.7	4.5	111.1	53.0	58.1	9.9	12.9
January 15th	---	0.6	0.4	0.3	57.1	53.0	4.1	100.5	44.7	55.8	8.8	13.2
L.S.D. at 0.05		0.3	0.06	0.05	0.9	0.8	0.1	1.2	1.7	1.3	0.1	0.2
---	Giza 20	0.7	0.5	0.4	68.9	64.4	4.5	128.2	72.1	56.1	10.0	13.6
---	Giza 6 M.	0.6	0.4	0.3	57.9	53.9	4.0	94.1	42.8	51.3	9.2	13.6
---	Composite	0.6	0.4	0.3	63.9	59.3	4.6	118.1	57.7	60.4	9.6	12.5
L.S.D. at 0.05		0.3	0.03	0.04	0.7	0.8	0.05	1.6	1.5	4.7	0.1	0.1
December 5th	Giza 20	0.8	0.6	0.4	77.7	73.0	4.7	153.9	98.4	55.5	10.8	14.5
	Giza 6 M.	0.7	0.5	0.4	64.5	60.5	4.0	98.2	49.0	49.2	9.6	13.4
	Composite	0.8	0.6	0.4	72.1	67.6	4.5	134.2	77.2	57.0	10.0	13.0
December 25th	Giza 20	0.7	0.5	0.4	67.2	62.7	4.5	115.7	60.5	55.2	9.9	13.0
	Giza 6 M.	0.6	0.4	0.3	57.6	53.5	4.1	104.4	44.1	60.3	9.7	13.4
	Composite	0.6	0.4	0.3	61.8	56.8	5.0	113.2	54.4	58.8	10.0	12.2
January 15th	Giza 20	0.6	0.4	0.3	61.9	57.6	4.3	114.8	57.3	57.5	9.3	12.9
	Giza 6 M.	0.6	0.4	0.3	51.7	47.8	3.9	79.8	35.3	44.5	8.4	13.3
	Composite	0.5	0.4	0.3	57.8	53.6	4.2	107.0	41.5	65.5	8.7	13.9
L.S.D. at 0.05		0.1	n.s.	n.s.	1.3	1.4	1.4	2.8	2.6	n.s.	0.1	0.2

it may be concluded that Giza 6-Mohassen cv. planting in January 15th had the lowest values in this respect compared with other treatments.

2.2. Effect on onion bulb yield and its components:

The effect of planting date and cultivar on onion bulb yield and its components, *i.e.* total and Marketable bulbs yield as well as average weight of bulb in both seasons for this study was illustrated in Table (10).

Respecting the effect of planting date, obtained data reveal that early planting, *i.e.* December 5th reflected the highest values in total and marketable bulbs yield as well as average bulb weight during both seasons of study compared with mid and late planting dates. Obtained results may be due to that early planting gave chance for the plants to grow vegetatively will as shown in Tables (8 & 9) and consequently such favourable effect reflected on produced yield of bulbs. Obtained results are in agreement with those of Omran and Awad (1979), Lisbao *et al.* (1986), Richwine (1990), Attar and Korla (1991), Orlowski and Rekowska (1992), Pandey *et al.* (1992), Abd El-Rehim (1994), Amin *et al.* (1995), Galmarini *et al.* (1995), Ali *et al.* (1996) and Dawood and Haydar (1996) all working on onion. They found that the earliest used planting date gave the highest bulbs yield and average bulb weight compared with other used planting dates. However, under different conditions, variable results were found. In this respect, Lopes (1987) working on onion in U.S.A., found that best bulbs yields were obtained between September 17th and November 14th. Whilase, under Brazili conditions, Guimaraes *et al.* (1988) working on onion also reported that the highest bulbs yield was obtained in August than in June transplanting. Meanwhile, Lallan *et*

al. (1991) dealing with onion also reported that bulbs yield was higher with planting on January 15th. On the other hand, Madisa (1993), testing the suitable planting date of onion, found that mid-March resulted in higher bulb yield than planting on mid-February or mid-April. In this respect, Pakyurek *et al.* (1994) found that autumn planting date produced higher onion bulbs yield than spring planting. It has been found also by Singh *et al.* (1995) that planting onion on July 25th gave the highest bulb yields under Indian conditions.

Respecting effect of planting date on the marketable bulb yield, many investigators showed that the highest marketable bulb yield was varied where the later planting date, as reported by Bhattarai *et al.* (1995) working on onion, significantly decreased the marketable bulb yield. However, under Brazili condition, Lisbao *et al.* (1986) working on onion showed that April is the best planting time for increasing marketable bulb yield.

Concerning the effect of the cultivar on the total and marketable bulb yields as well as average weight of bulb as shown by data presented in Table (10), significant increments in this respect were detected as a result of using Giza 20 or Composite cultivars than the values of Giza 6-Mohassen cv. Such results may be attributed to that the Giza 20 cv. is well adapted for environmental conditions similar to those of this experiment. Such supperiority of Giza 20 cv. under the conditions of Delta region, particulary in this time of planting (winter season) is also due to the suitability of photoperiod and temperature which are considered as the factors that well known to affect growth and bulbing behaviour of onion. Obtained results, showing the variable effect of used cv. and the superiority of some of them than

others, are in agreement with those reported by many investigators working on onion crop. Among them were Omran and Awad (1979) who found clear significant increase in bulb yield of Behairy over Giza 6 cv. of onion. Lisbao *et al.* (1986) reported also that total and Marketable bulb yields and average weight of bulb of Crioula cv. was greater than other used cvs. Moreover, Lopes (1987) concluded that Rio Grande, special 38, Asqrow 429 and Texas Grano 1015Y cvs. produced significantly higher bulb yields than other used cvs. Similarly, Khalil *et al.* (1988b) found that Giza 20 cv. achieved the highest total and merketable bulb yields compared with Giza 6-Mohassen and Shandweel No. 1 cvs. In this respect, Attar and Korla (1991) reported that maximum bulb yields were obtained with poona Red and Nasik Red cvs. Such variations between cvs. were also found by Lallan *et al.* (1991) who found that pusa Red cv. gave higher bulb yield than N-53 cv. Similarly, Bon *et al.* (1992) found that violet de Galmi, gave good yields under hot conditions. Moreover, Jitendra *et al.* (1992) found that Pusa White Round, Pusa White Flate and Hisar 2 cvs. had the highest bulb yield, respectively. Meanwhile, Daymond *et al.* (1997) found also that a beneficial effect on onion bulb production, particulary for long-season cvs. was reported. Orlowski and Rekowska (1992) reported also that wolska cv. gave higher average bulb yield than other cvs. In this respect, Ramiraz and Kline (1992) reported also that Granex 429-A produced significantly higher bulb yields than 10 other cvs. Such differences between cvs. were also reported by Pakyurek *et al.* (1994) who found that the cvs. of SG 936, Ben Shemen, Akgun 12 and Corum produced the highest bulb yield. In this respect, findings reported by Warid and Loaiza (1993) showed also

Table (10): Effect of planting date and cultivar on onion bulbs yield and its components.

Treatments		Season 1995-1996					Season 1996-1997				
Plant date	Cultivar	Total yield (ton/fed.)	Market-able yield (ton/fed.)	Average weight/ bulb (g)	% of No. doubles bulb	% of No. bolters bulb	Total yield (ton/fed.)	Market-able yield (ton/fed.)	Average weight/ bulb (g)	% of No. doubles bulb	% of No. bolters bulb
December 5th	---	17.772	17.299	146.1	1.5	3.2	16.532	15.478	121.1	2.0	2.8
December 25th	---	14.408	13.933	126.1	1.7	0.2	10.275	10.004	72.6	0.6	0.1
January 15th	---	9.011	8.342	79.5	0.5	0.1	5.549	5.522	51.8	0.2	0.1
L.S.D. at 0.05		0.5	0.5	2.9	0.2	0.1	0.5	0.6	3.9	0.2	0.2
---	Giza 20	14.777	14.284	124.1	1.6	1.0	12.316	11.869	95.0	1.2	1.5
---	Giza 6 M.	11.668	11.173	104.3	2.0	1.1	7.785	7.399	64.5	0.7	0.7
---	Composite	14.737	14.119	123.3	0.5	1.5	12.254	11.736	85.6	0.9	0.9
L.S.D. at 0.05		0.4	0.4	3.6	0.2	0.1	0.4	0.2	3.2	0.1	0.1
December 5th	Giza 20	19.062	18.611	168.5	2.6	2.4	19.921	18.722	145.0	2.8	4.3
	Giza 6 M.	14.207	14.029	121.0	2.5	2.7	12.250	11.109	95.2	1.7	1.9
	Composite	20.048	19.259	148.8	0.7	4.6	17.425	16.604	123.1	1.6	2.4
December 25th	Giza 20	16.033	15.275	130.1	1.5	0.1	10.081	9.974	77.6	0.4	0.1
	Giza 6 M.	12.035	11.563	111.3	2.8	0.5	7.355	7.339	63.1	0.4	0.1
	Composite	15.155	14.963	137.1	0.7	0.1	13.389	12.700	77.0	1.0	0.1
January 15th	Giza 20	9.236	8.965	73.6	0.7	0.1	6.947	6.911	62.4	0.4	0.1
	Giza 6 M.	8.763	7.927	80.7	0.8	0.1	3.750	3.749	36.4	0.1	0.1
	Composite	9.008	8.135	84.1	0.1	0.1	5.949	5.905	56.7	0.1	0.1
L.S.D. at 0.05		0.6	0.7	6.2	0.3	0.2	0.7	0.3	5.5	0.2	0.2

that, total and Marketable bulbs yield were significantly affected by cvs. where the red cvs. [Rojo and Red Comet cvs.] gave lower marketable bulbs than those of the yellow/brown cv. Such varietal differences were found by Salazar *et al.* (1995) who reported also that Hybrid yellow Granex produced the highest bulb total yields while, Cuba white red, yellow and white cvs. Successfully produced higher marketable onion bulbs yield, Moreover, El-Kafoury *et al.* (1996) reported that the highest total bulbs yield of onion was produced from Composite 16 cv. Moreover, they found that Composite 16, Behairy no Pinck and Giza 20 cvs. were the favourable cvs. for Marketable bulbs yield. Meantime, Warid *et al.* (1996) indicated that bulbs yield was significantly affected by cvs.

Respecting to the effect of interaction between planting date and cultivars on total and marketable bulbs yield as well as average weight of bulb, data presented in Table (11) show that significant differences were noticed in this regard. Such data show clearly that early planting on December 5th and using of Giza 20 cv. or Composite gave the highest values of studied yield characters in both saesons of this work compared with Giza 6-Mohassen. Obtained results are in confirmity with those of Lopes (1987), Orlowski and Rekowska (1992) and Bhattarai *et al.* (1995) who reported that bulbs yield were significantly affected by interaction between planting date and cultivars.

Generally, it may be advisable under such conditions of this experiment, that Giza 20 or composite cvs. transplanted in early planting date, *i.e.* December 5th are recommended for obtaining higher total and marketable bulbs yield compared with other transplanting dates and cvs.

Concerning the effect of transplanting date on onion bulbs doubling, boltering and T.S.S. %, obtained results show that such percentages were significantly increased in case of early transplanting date (December 5th) compared with other used dates in both growing seasons of this work. Obtained results are in agreement with those of Omran and Awad (1979) working on onion who reported that the earliest transplanting produced the greater number of bolters but no significant differences were found in number of double bulbs. However, Bahamburkar *et al.* (1986) found that bolting of onion was lower with January planting than December or February under indian conditions. In this regard, Lisbao *et al.* (1986) showed also that the planting time of onion seedling affected bolting % where April planting proved to be the best time. Similar results were reported by Madisa (1993) on onion who found that percentage of bolting bulbs was higher in early planting date (mid-February). However, Abd El-Rehim (1994) reported that percentages of external doubling and bolting were significantly decreased by planting on February 5th, in Botswana conditions. Moreover, findings under Nepal conditions, which were reported by Bhattarai *et al.* (1995) showed that the bolting of onion bulbs rate was high for the first and secohd planting dates, while there was no boltering with later one.

Respecting the effect of used cultivar on the doubling and bolting bulbs % as well as T.S.S. content of bulbs, the highest values were obtained in case of Giza 20 cv. in the second season but Giza 6-Mohassen cv. had the highest values in the first season in this study. The varietal differences in this respect were also reported by many investigators such as Bhamburkar *et al.* (1986), Lisbao *et al.* (1986),

Lopes (1987), Khalil *et al.* (1988b), Bajaj *et al.* (1990), Grant and Carter (1991), Jitendra *et al.* (1992), Ramirez and Kline (1992), Warid and Loaiza (1993), Bhattarai *et al.* (1995), Salazar *et al.* (1995), El-Kafoury *et al.* (1996), Resende *et al.* (1996) and Warid *et al.* (1996) all working on onion. They reported that percentage of bolting, Split bulb and T.S.S. were significantly affected by different cvs. On the other hand, Omran and Awad (1979) on onion indicated that no significant differences were found in the number of bolting bulbs, while significant differences in number of double bulbs between varieties were reported.

With regard to the interaction between planting date and cultivars on affecting some of different studied yield components characters, data presented in Table (10) show that such characteristics were significantly affected in this respect. It is evident, in general, that transplanting either Giza 20 or Composite cvs. in the early transplanting date (December 5th) resulted in higher values of most of the studied characters than those of Giza 6-Mohassen cv. when planted at late planting date. Obtained results showing the significancy of the combined effect in this respect are in agreement with those reported by Bhamburker *et al.* (1986) and Bhattarai *et al.* (1995) working on onion.

Under similar conditions of this work, it may be recommended to grow either Giza 20 or Composite cvs. of onion in the earliest used planting date, *i.e.* December 5th to obtain bulbs of the highest total and marketable yield and average bulb weight but not of less percentage of bolters and doubles than those of Giza 6-Mohassen in the other used planting dates (medium at December 25th or late at January 5th ones).

This advise is mainly due to that the variations of the values of bulb bolters and doubles percentages are not so hight. Hence, clear variations of the total and marketable bulb yields and the superiority of such adviced treatments makes this recommendation true at both seasons of this work.

2.3. Onion bulbs quality parameters:

Data presented in Table (11) show the effect of transplanting date and cultivar on some quality parameters, *i.e.* bulb shape index, number and thickness of complete rings/bulb , number of growing centers.

Concerning the effect of transplanting date, obtained results show that number and thickness of complete rings per bulb and number of growing centers per bulb, were significantly increased in case of early transplanting date (December 5th) compared with other used dates in both growing seasons of this work.

With regard to the effect of planting date on the shape index, no significant effect may be detected at both growing seasons of this work. Obtained results are in agreement with those of Grant and Carter (1991) working on onion who decided that delaying the sowing date from June to September gave decrease in shape index under New Zeland conditions.

Respecting the effect of used cultivars on the bulbs quality, data shown in Table (11) reveal that all studied characters except shape index of bulbs were significantly affected. In this respect, the values of bulb shape index as well as number and thickness of complete rings were higher with Composite cv. followed by Giza 20 cv. and then Giza 6-Mohassen cv. in both growing saesons. Meanwhile, number of

growing centers per bulb did'n behave the same in different studied cvs. where, Giza 6-Mohassen cv. had the highest values of No. of growing centers per bulb in the two seasons of this study. The varietal differences in this respect were also reported by many investigators such as Bhamburker *et al.* (1986), Lisbao *et al.* (1986),Lopes (1987), Khalil *et al.* (1988b), Bajaj *et al.* (1990), Grant and Carter (1991), Jitendra *et al.* (1992), Ramirez and Kline (1992), Warid and Loaiza (1993), Bhattarai *et al.* (1995), Salazer *et al.* (1995), El-Kafoury *et al.* (1996), Resende *et al.* (1996) and Warid *et al.* (1996) all working on onion. They reported that the bulb shape index and the number of rings as well as other bulb characters were significantly affected by different cvs.

Respecting the interaction between planting date and cultivar affecting the different studied bulb quality characters, data presented in Table (11) show that such characteristics were significantly affected in this respect. It is evident, in general that transplanting either Giza 20 or Composite cvs. in the early transplanting date (December 5th) resulted in higher values of most of the studied characters than those of Giza 6-Mohassen cv. when planted at late planting date. The exception, in this respect, was that of number of growing centers per bulb which showed higher valus in Giza 6-Mohassen cv. when grown on the early date (December 5th). However, the bulb shape index was not significantly affected by interaction between planting date and cv. in both seasons of this work. Obtained results showing the significancy of combined effect in this respect are in agreement with those reported by Bhamburkar *et al.* (1986) and Bhattarai *et al.* (1995) working on onion.

Table (11): Effect of planting date and cultivar on onion bulbs quality.

Treatments		Season 1995-1996					Season 1996-1997				
Plant date	Cultivar	Shape index	No. of complete rings/bulb	Thickness of complete rings/bulbs (cm)	No. of growing centers/bulb	% T.S.S.	Shape Index	No. of complete rings/bulb	Thickness of complete rings/bulbs (cm)	No. of growing centers/bulb	% T.S.S.
December 5th	---	0.7	5.4	2.3	3.1	14.1	0.7	5.7	2.4	2.0	15.1
December 25th	---	0.7	4.5	1.6	2.5	12.2	0.7	4.9	1.9	2.2	14.5
January 15th	---	0.7	4.4	1.5	2.0	13.5	0.7	4.2	1.8	2.0	14.0
L.S.D. at 0.05		n.s.	0.1	0.1	0.1	0.5	n.s.	0.1	0.1	0.1	0.3
---	Giza 20	0.7	5.0	1.8	2.7	15.0	0.7	5.0	2.0	2.1	15.4
---	Giza 6 M.	0.7	4.4	1.6	2.8	13.9	0.7	4.6	1.9	2.3	14.1
---	Composite	0.8	5.1	2.0	2.2	12.9	0.8	5.2	2.2	1.8	14.1
L.S.D. at 0.05		0.03	0.1	0.1	0.1	0.4	0.04	0.1	0.1	0.1	0.2
December 5th	Giza 20	0.7	5.4	2.1	3.7	14.9	0.7	6.1	2.5	1.9	16.0
	Giza 6 M.	0.6	5.1	2.0	3.3	14.3	0.7	5.0	2.1	2.4	15.0
	Composite	0.7	5.9	2.7	2.4	13.2	0.8	5.9	2.6	1.8	14.4
December 25th	Giza 20	0.7	4.9	1.8	2.5	15.4	0.7	4.8	1.9	2.2	15.5
	Giza 6 M.	0.7	3.8	1.4	2.7	13.5	0.6	4.8	1.9	2.5	13.3
	Composite	0.8	4.9	1.7	2.4	13.6	0.8	5.0	2.0	2.0	14.6
January 15th	Giza 20	0.7	4.6	1.5	1.9	14.8	0.7	4.0	1.7	2.2	14.8
	Giza 6 M.	0.7	4.2	1.4	2.3	13.8	0.7	4.0	1.7	2.1	14.0
	Composite	0.8	4.4	1.6	1.9	12.0	0.8	4.7	1.9	1.7	13.2
L.S.D. at 0.05		n.s.	0.1	0.1	0.1	0.7	n.s.	0.2	0.1	0.1	0.4

Under similar conditions of this work, it may be recommended to grow either Giza 20 or Composite cvs. of onion in the earliest used planting date, *i.e.* December 5th to obtain onion bulbs of better quality than those of Giza 6-Mohassen cv. in the other used planting dates (medium at December 25th or late at January 15th).

2.4. Effect on storageability of onion bulbs:

Respecting the effect of planting date and cultivar on storageability parameters, *i.e.* percentages of sprouting, rotten, total weight loss and marketable bulbs at the end of storage period, data presented in Table (12) show that all the studied characters were significantly affected by planting date in both seasons of this work. In this respect, such data show that late planting on January 15th gave the highest values of each of sprouting, rotten and weight loss in the first season. However, early planting on December 5th produced the highest values of the percentage of sprouting and rotten bulbs in the second one. Furthermore, the highest values of the marketable bulbs in the end of the storage period were obtained as a result of planting on December 20th, *i.e.* at mid planting date during both seasons of study. On the other hand, early and late planting resulted in the lowest values of marketable bulbs compared with the mid planting date.

The effect of planting date on the storageability of onion bulbs was studied by many investigators, among them was Abd El-Rahim (1994) who found that planting date had significant effect on percentages of weight loss (Total weight loss and decay loss) where onion bulbs which were produced from November 15th planting were of greater weight loss in store than those of February 5th planting.

However, no significant effect on decay loss percentage was found in this respect,

Regarding the effect of cultivar on the studied storageability parameters, data presented in Table (12) show that significant effects are detected in this respect in both seasons of this work. Such data show that Giza 20 cv. proved to be the significantly best cultivar where it had the lowest percentage of sprouting, rotting and total weight loss as well as the hightest marketable bulbs percentage during the two seasons of the storage when compared with other two used cultivars. Meanwhile, Composite cv. came in the second rank while Giza 6-Mohassen cv. was the worst. In this respect, Khalil *et al.* (1988b) working on onion showed that Giza 6-Mohassen cv. had, in general the highest losses in bulb weight. They also found that no significant variation when compared by Shandaweel No. 1 cv. was reported while Giza 20 cv. significantly came the latest in this respect. However, Gabal *et al.* (1989) found that Giza 20 cv. resulted in the highest storageability followed by Behairy, Giza 6-Mohassen and Shandweel No. 1. While TYG cv. had the lowest storageability as compared with the other tested cvs. Moreover, Patil and Kale (1989) found that Seroli 1 cv. was of the lowest storage loss (29.25%) than VL 1 cv. which had (9.4%) of storage loss. Meanwhile, Kacjan and Osvald (1992) working on onion found that Belokranjka cv. was of better keeping quality than the other two tested cvs. Meantime, Miedema (1994) and Hill (1994) mentioned that from used 17 cvs. of onion valiant and Riverside spanish cvs. had the longest storage life where the losses of sprouting were less than 25% after 19 weeks in cold storage. Moreover, El-Kafoury *et al.* (1996) concluded that bulbs

However, no significant effect on decay loss percentage was found in this respect,

Regarding the effect of cultivar on the studied storageability parameters, data presented in Table (12) show that significant effects are detected in this respect in both seasons of this work. Such data show that Giza 20 cv. proved to be the significantly best cultivar where it had the lowest percentage of sprouting, rotting and total weight loss as well as [illegible] bulbs percentage during the two seasons of the storage when compared with other two used cultivars. Meanwhile, Composite cv. came in the second rank while Giza 6-Mohassen cv. was [illegible] Giza 6-Mohassen cv. (1988b) [illegible] losses in bulb weight. They also found that no general [illegible] significant variation when compared by Shandaweel No. 1 cv. was recorded while Giza 20 cv. significantly came the latest in this respect. However, Gabal *et al.* (1982) found that Giza 20 cv. resulted in the lowest storageability followed by Beauty. Giza-[illegible] and Shandaweel No. 1 which [illegible] that the highest storageability as compared with the other tested cvs. Moreover, Patil and Kale (1989) found that Seroli 1 cv. was of the lowest storage loss (29.25%) than Nasik cv. which had 41.4% storage loss. Meanwhile, Kacjan and Osvald (1992) working on onion found that Edolenanika cv. was of the best keeping quality than the other two used cvs. Meantime, Mohamma (1994) and [illegible] mentioned that from used 17 cvs. of [illegible] and [illegible] Giza Red was had the longest storage life

Table (12): Effect of planting date and cultivar on the storageability of onion bulbs.

Treatments		Season 1995-1996				Season 1996-1997			
Plant date	Cultivar	Sprouting percentage as No.	Rotting percentage as No.	Total weight loss percentage	Marketable bulbs percentage as weight	Sprouting percentage as No.	Rotting percentage as No.	Total weight loss percentage	Marketable bulbs percentage as weight
December 5th	---	8.3	16.9	18.5	66.6	9.7	2.8	17.6	74.0
December 25th	---	6.8	13.5	20.2	68.2	8.0	1.9	25.0	75.6
January 15th	---	11.3	23.5	30.1	61.4	6.7	2.0	25.9	72.1
L.S.D. at 0.05		1.8	1.4	1.4	3.0	0.2	0.3	0.2	2.0
---	Giza 20	4.5	11.5	15.8	74.8	0.6	1.9	15.3	83.9
---	Giza 6 M.	20.8	26.7	33.3	49.1	23.1	2.8	30.1	57.2
---	Composite	1.0	15.7	19.8	72.3	0.7	2.0	23.1	80.6
L.S.D. at 0.05		1.0	0.9	1.0	2.1	0.2	0.2	0.2	1.5
December 5th	Giza 20	4.3	13.7	14.7	75.8	0.9	1.6	15.8	81.4
	Giza 6 M.	19.7	18.7	23.4	49.8	27.4	3.6	22.1	56.4
	Composite	0.9	18.3	17.4	74.3	0.9	3.2	15.0	84.1
December 25th	Giza 20	0.9	7.6	13.4	79.3	0.5	2.8	16.5	83.6
	Giza 6 M.	18.3	20.4	27.6	51.0	23.1	1.8	27.8	60.0
	Composite	1.1	12.6	19.8	74.3	0.5	1.1	30.8	83.2
January 15th	Giza 20	8.4	13.2	19.2	69.2	0.5	1.3	13.7	86.6
	Giza 6 M.	24.3	41.0	48.9	46.5	18.8	3.0	40.5	55.1
	Composite	1.1	16.3	22.1	68.4	0.7	1.7	23.5	74.6
L.S.D. at 0.05		1.8	1.6	1.8	n.s.	0.9	0.3	1.3	2.5

of Composite 16, Giza 20 and Behairy no pinck proved to be the best in keeping qulity, while Hazera 7 was the worst one in storageability under Egyptian conditions.

Concerning the effect of interaction between planting date and cultivar on the percentage of sprouting, rotting, total weight loss and marketable bulbs during storage period, data presented in Table (12) show that such characters are significantly affected in this respect in both seasons of this work. Such results show that planting Giza 20 cv. on December 25th in the first season and on January 15th in the second one resulted in the best keeping quality [the lowest percentages of sprouting, rotting and total weight loss and the highest marketable bulbs percentage]. Contra results were obtained by Giza 6-Mohassen cv. when planted on the late date [15th of January] showing the worst keeping quality during both seasons of this work.

In this respect, it could be advisable, under similar conditions of this work, that planting Giza 20 or Composite cvs. on December 25th is preferable for getting onion bulbs of better keeping qulity more than planting Giza 6-Mohassen cv. at other used planting dates [either early or late at December 5th or January 15th].

2.5. Effect on keeping quality of onion bulbs during the storage period:

Regarding the effect of planting date and cultivar on keeping quality of onion bulbs, during storage for five months, data presented in Tables (13 & 14) show the percentage of sprouting, rotting, total weight loss and marketable bulbs during the storage period starting from July 15th up to December 15th in both seasons of this work.

Table (13): Effect of planting date and cultivar on keeping quality of onion bulbs during storage for five months in 1995-1996 season.

Treatments		1st month				2nd month				3rd month				4th month				5th month			
Planting date	Cultivar	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %
December 5th	---	0	2.428	1.972	97.08	0.083	3.692	3.061	89.17	0.113	4.209	3.177	80.42	2.010	4.260	4.299	72.92	5.781	2.086	5.149	66.33
December 25th	---	0	2.750	3.671	95.92	0	3.856	4.151	87.83	0.453	4.262	3.159	79.58	1.630	1.487	2.689	74.00	4.474	1.198	5.611	67.92
January 15th	---	0	2.277	2.497	97.00	0	3.830	3.277	89.08	0	7.819	5.684	77.92	3.573	6.338	8.165	66.25	7.377	3.416	8.064	60.58
---	Giza 20	0	1.724	2.568	97.00	0	2.076	2.339	91.75	0	5.452	2.438	83.92	1.547	2.661	3.133	78.83	2.596	1.871	3.485	74.75
---	Giza 6 M.	0	2.629	3.624	95.17	0.083	5.981	4.937	83.92	0.566	8.649	6.800	71.67	5.138	5.927	9.095	58.58	14.775	3.240	14.283	48.08
---	Composite	0	3.102	1.948	97.83	0	3.322	3.113	90.42	0	4.190	2.783	82.33	0.437	3.497	2.926	75.75	0.260	1.589	1.047	72.00
December 5th	Giza 20	0	1.695	2.594	97.00	0	0.973	1.031	93.00	0	4.772	3.194	84.00	1.007	4.144	3.573	79.25	2.934	2.091	2.467	75.75
	Giza 6 M.	0	0.968	1.478	96.25	0.248	5.903	4.180	83.50	0.339	4.999	4.339	74.25	4.514	4.072	5.583	63.00	14.409	2.829	12.328	49.50
	Composite	0	4.620	1.844	98.00	0	4.201	3.972	91.00	0	2.857	1.999	83.00	0.508	4.564	3.740	76.50	0	1.339	0.633	73.75
December 25th	Giza 20	0	2.117	3.444	96.00	0	2.928	2.956	90.00	0	1.487	1.068	84.25	0.509	0.486	0.679	81.75	0.298	0.550	1.339	79.00
	Giza 6 M.	0	3.477	2.831	94.25	0	5.412	6.744	82.75	1.358	6.339	5.515	72.00	3.877	3.134	6.036	62.75	12.907	2.074	14.695	50.75
	Composite	0	2.657	1.739	97.50	0	3.228	2.453	90.75	0	4.961	2.895	82.50	0.533	0.841	1.352	77.50	0.267	0.971	0.798	74.00
January 15th	Giza 20	0	1.359	1.665	98.00	0	2.326	3.031	92.25	0	4.096	3.053	83.50	3.425	3.352	5.146	75.50	4.607	2.972	6.648	69.50
	Giza 6 M.	0	3.441	3.564	95.00	0	6.629	3.886	85.50	0	14.610	10.545	68.75	7.024	10.575	15.665	50.00	17.010	4.818	15.825	44.00
	Composit	0	2.030	2.261	98.00	0	2.536	2.913	89.50	0	4.752	3.455	81.50	0.269	5.086	3.685	73.25	0.513	2.457	1.709	68.25

T.W.L. = Total weight loss.

Table (14): Effect of planting date and cultivar on keeping quality of onion bulbs during storage for five months in 1996-1997 season.

Treatments		1st month				2nd month				3rd month				4th month				5th month			
Planting date	Cultivar	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %	Sprouting No. %	Rotting No. %	T.W.L weight %	Mark. weight %
December 5th	---	0	0.224	1.253	93.58	0	1.012	0.853	89.83	0.145	0.581	0.168	86.42	0.193	0.579	0.904	83.50	9.116	0.075	8.745	73.92
December 25th	---	0	0.598	0.293	93.25	0	0.496	0.504	89.92	0.092	0.232	0.430	86.50	0	0.355	0.800	83.42	7.497	0	7.278	75.42
January 15th	---	0	0.359	1.066	93.58	0	0.677	0.449	91.17	0	0.283	0.044	87.08	0	0.443	0.504	84.23	6.383	0	5.550	72.00
---	Giza 20	0	0.598	0.769	93.58	0	0.916	0.667	90.17	0.072	0	0.024	88.17	0.043	0.043	0.262	85.67	0.146	0	0.160	83.92
---	Giza 6 M.	0	0.343	0.465	92.58	0	0.543	0.520	89.17	0.165	0.446	0.501	83.50	0	1.099	1.392	79.67	22.762	0	21.29	57.00
---	Composite	0	0.155	1.368	94.17	0	0.726	0.619	88.25	0	0.650	0.117	88.33	0.150	0.236	0.554	85.83	0.088	0.075	0.119	80.42
December 5th	Giza 20	0	0	1.430	92.50	0	1.119	1.080	88.25	0.217	0	0.072	86.50	0.130	0.130	0.589	84.00	0.438	0	0.481	81.50
	Giza 6 M.	0	0.673	1.040	93.75	0	0.980	0.720	89.25	0.220	0.247	0.297	84.75	0	1.132	1.381	80.75	26.909	0	25.444	56.25
	Composite	0	0	1.290	94.50	0	0.936	0.758	92.00	0	1.497	0.136	88.00	0.450	0.476	0.741	85.75	0	0.225	0.309	84.00
December 25th	Giza 20	0	1.793	0.878	92.75	0	0.707	0.337	90.00	0	0	0	88.00	0	0	0.197	85.25	0	0	0	83.50
	Giza 6 M.	0	0	0	93.50	0	0.287	0.641	90.25	0.775	0.467	1.075	85.25	0	0.835	1.703	80.75	22.492	0	21.832	59.75
	Composite	0	0	0	93.50	0	0.493	0.535	89.50	0	0.229	0.214	86.25	0	0.231	0.502	74.25	0	0	0	83.00
January 15th	Giza 20	0	0	0	95.50	0	9.22	0.583	92.25	0	0	0	90.00	0	0	0	87.75	0	0	0	86.75
	Giza 6 M.	0	0.610	0.356	90.50	0	0.362	0.200	88.00	0	0.625	0.131	80.50	0	1.329	1.093	77.50	18.886	0	16.602	55.00
	Composit	0	0.466	2.813	94.50	0	0.748	0.564	83.25	0	0.223	0	90.75	0	0	0.419	87.50	0.263	0	0.047	74.25

T.W.L. = Total weight loss.

Concerning the effect of planting date on such studied keeping quality characters, the same data clearly show that the characters, *i.e.* rotting, sprouting, total weight loss and marketable yield percentages were affected by planting date during storage period. The highest value of rotting % was for December 5th planting during storage period in August 15th, while the highest values of sprouting and total weight loss percentages were at the end of storage period (on December 15th) in case of planting at the early planting date (at December 5th) compared with other planting dates during storage period in the first season. Meanwhile, the rotting bulbs% had the highest values on January 15th planting date in storage period of September 15th. Moreover, the sprouting and total weight loss percentages showed the highest values in case of late planting date (January 15th) in the last storage period (December 15th) compared with other treatments.

Concerning the effect of cultivar on keeping quality of onion bulbs during storage periods, the same data in Tables (13 & 14) show that all characters were affected by cultivar where Giza 6-Mohassen had higher values than other tested cvs., *i.e.* Giza 20 or composite which were of better storageability in both seasons of this study during storage period.

As the effect of interaction between the two studied factors on the keeping quality characters of onion bulbs during storage for a period of five months, it is evident that the highest total weight loss percentage due to sprouting, rotting and weight loss and consequently the lowest percentage of marketable bulbs were obtained with the

Giza 6-Mohassen cv. when planted at the late planting date (January 15th). In other words, it may be concluded that the lowest percentage of marketable bulbs were obtained with the Giza 6-Mohassen cv. when planted at the late planting date (January 15th) and also planting the two cultivars Giza 20 and Composite cvs. of onion at the early used planting date (December 5th and 25th) produced bulbs which were of the best keeping quality during a storage period of five months and surpassed those of Giza 6-Mohassen cv. when planted at the other used planting dates (medium or late ones). In this respect, Gabal *et al.* (1987) found that the monthly storage loss differed where it was somewhat high in the first month then increased in August, and decreased until November. They mentioned also that prolonging storage period led to a sharp increase in weight loss during the last three months. So, it is not advisable to store onion bulbs more than 6 months. Obtained results were also supported by those of Singh *et al.* (1996) working on onion who found that loss resulting from rotting and physiological weight loss (P.W.L.) was high in May when temperature was high. They found also similar results which were in confirmity with that reported herein where monthly loss was lower in June-August and then increased significantly, being of the highest values in October under Indian conditions. The varietal differences were also reported by Gregoriou (1998) on onion who reported that cultivar Ben shemen was of the best keeping qulaity after 7 months in storage.

3. THIRD EXPERIMENT: Effect of cultivar and seedling size on bulbs yield and its components:

3.1. Total bulbs yield:

Data showing the total bulbs yield of two studied cvs. of onion as affected by the different sizes of seedling in both growing seasons of this work are presented in Table (15). Such data show clearly that the total bulb yield was significantly affected by both studied factors, *i.e.* cultivar and seedling size

Concerning the effect of cultivar, Giza 20 cv. gave higher bulb yield than that of Giza 6-Mohassen cv. in both seasons of study. Obtained results may be due to that Giza 20 cv. is more adopted to planting in lower Egypt than Giza 6M cv. which is more suitable for upper Egypt conditions. Such results are in agreement with those reported by Omran and Awad (1979), Lisbao *et al.* (1986), Lopes (1987), Khalil *et al.* (1988b), Aravjo *et al.* (1989), Koriem and Farag (1990), Attar and Korla (1991), Lallan *et al.* (1991), Bon *et al.* (1992), Ramirez and Kline (1992), Warid and Loaaiza (1993), Pakyurek *et al.* (1994), Salazar *et al.* (1995), El-Kafoury *et al.* (1996) and Warid *et al.* (1996). They reported that there was a clear variation between the studied cultivars in its production ability.

With regard to the effect of seedling size on bulb yield, the same data presented also in Table (15) show that the total bulb yield was significantly affected during both growing seasons of this study. In this regard, increasing seedling size gradually and significantly increased the total yield of onion bulb where using the seedlings with diameter < 16 mm resulted in the highest values of total bulbs yield compared with other sizes of seedling. Such improving effect of

higher onion seedlings size on the produced total bulbs yield was also reported by many investigators, among them were Abou-Zeyed (1978), El-Murabaa *et al.* (1979), Sabota and Downes (1981), Yamashita *et al.* (1986), Vachhani and Patel (1988 and 1990), Koriem and Farag (1990) and Shalaby *et al.* (1991b) all working on onion, Rahim *et al.* (1984), Blyshchik and Furman (1987) and Wardjito *et al.* (1988) working on garlic. They found that the total bulbs yield significantly increased with each increase in size of transplants and the highest total bulbs yield was obtained from large-size seedling. They reported also that there was a relationship between size of seedling and physiological growth stage (old of seedling/days) of seedling where increasing its size was due to increased transplant age. In this respect, El-Hardun (1975), Moursi *et al.* (1973), El-Murabaa *et al.* (1979), Farag (1985) and Koriem and Farag (1990) all working on onion seedling age showed a significant effect of seedling age on onion bulbs total yield. On the other hand, Singh *et al.* (1995) reported that bulb yield did not significantly differ due to different ages of the seedling. Regarding effect of weight of cloves, Orlowski and Rekowska (1989) on garlic found that the highest yield was produced from the heaviest used cloves (5.0 g). Moreover, Madisa (1993) in a trial comparing 3 sizes of sets found that bulbs yield of onion was the highest (45.4 ton/ha.) with the medium sized sets (0.75-1.0 cm) while large and smaller sets (1.0-1.25 and 0.5-0.75 cm) produced yields of 37.6 and 30.6 ton/ha., respectively.

Concerning the effect of interaction between cultivar and size of seedling on the total yield of onion bulbs, the data presented in Table (15) show that there were clear variations between different

combinations but such differences were significant only in the second season of this work. Obtained results in this respect disagreed with those of koriem and Farag (1990) working on onion where they found that the interaction between cultivar viz seedling size was not significant.

3.2. Marketable bulbs yield:

The data illustrated in Table (15) obviously show that the marketable bulbs yield of onion was significantly affected by the used seedling size and variety as well as their interaction in the two seasons of this work.

Respecting effect of the cultivars, Giza 20 cv. surpassed that of Giza 6-Mohassen in both seasons of this study where signifiacnt increments are detected in this cocern with using Giza 20 cv. Obtained results may be due to increased total bulb yield and decreasing culls bulbs in Giza 20 cv. compared with Giza 6-Mohassen. Such findings are in agreement with those of each of Khalil *et al.* (1988b), Warid and Loaiza (1993), Salazar *et al.* (1995), El-Kafoury *et al.* (1996) and Resende *et al.* (1996).

With regard to the effect of seedling size on marketable bulbs yield, the same data presented in Table (15) show that significant increments are obtained in this respect in the two growing seasons of this study where the largest used seedling of size (< 16 mm) gave the highest marketable bulbs yield when compared with the other used sizes of seedling. In this respect, obtained results are disagreeable with those of Abou-Zayed (1978) who reported that exportable bulbs yield was produced from the smallest sizes of onion seedling. Contra results were also reported by Strydom (1965), Saraymeza (1986), Koriem and

Farag (1990) and Shalaby *et al.* (1991b) who found that large seedlings of onion plant gave the lowest exportable bulbs yield compared to others in both seasons. They explained this result to that it may be due to the higher percentage of doubles and bolters in case of using large seedlings than with small ones. In this respect, using different weights of cloves in garlic, Orlowski and Rekowska (1989) found that the best quality was produced from large cloves (5 g).

Regarding the effect of interaction between the tested cultivars and seedling size on marketable bulbs yields, data presented in Table (15) show that marketable bulbs yield was significantly affected where the largest used seedling of Giza 20 cv. produced the highest values in this respect. The obtained results are in agreement with those reported by Koriem and Farag (1990) working on onion where they found that the interaction between cv. X size of seedling was of significant effect in this respect.

3.3. Average bulb weight:

The data shown in Table (15) for the average bulb weight as affected by different used seedling size of the two tested cvs. in both growing seasons of this work reveal that the average bulb weight was significantly affected by both used factors, *i.e.* cv. and seedling size in this work.

With regard to the effect of cultivar, such data show that Giza 20 cv. produced bulbs of higher average weight than those of Giza 6-Mohassen cv. in both growing seasons. In this respect, Lisbao *et al.* (1986) working on onion reported that there were clear variations in the bulb weight of studied cvs. On the other hand, Koriem and Farag

(1990) revealed that cv. of onion had no significant effect on this character.

Concerning the effect of seedling size on average bulb weight, the same data presented in Table (15) show clearly that using seedlings of higher size (< 16 mm) produced bulbs of higher average weight than those of medium ones (8-16 mm) and those of small ones (> 8 mm). Obtained results are in agreement with those of EL-Murabaa *et al.* (1979), Yamashita *et al.* (1986), Vachhani and Patel (1988 and 1990) and Shalaby *et al.* (1991) working on onion where they found that average of bulb weight progressively increased with each increase in transplants size.

On the other hand, Abou-Zayed (1979) reported that this character was not significantly affected by swelling of transplant base. Moreover, Koriem and Farag (1990) working on onion revealed that seedling size had significant effect on the percentage of small bulbs in both seasons, where the large size seedlings gave the lowest percentage of small bulbs as comparison with the seedling of small size.

Respecting the interaction between the two studied factors, *i.e.* cultivar and seedling size on average bulb weight, data presented in Table (15) show that average bulb weight was significantly affected by interaction between cvs. and seedling size. Such data reveal that the response of cvs. to seedling size was more pronounced at the large size than at small one where the seedling of Giza 20 cv. gave the highest average bulb weight in both seasons of this work. The obtained results are in agreement with those found by Koriem and Farag (1990) who reported that the interaction between cultivar X size

of seedling was of significant effect. Moreover, similar findings were reported by the same researchers who found that the interaction between cv. X seedling age was of significant effect where the highest percent of small bulbs was produced by young seedling of some cultivars.

3.4. Percentage of doubling (split bulbs):

Data showing the percentage of double bulbs of onion as affected by cultivar and seedling size as well as their interaction are presented in Table (15). Such data indicate that, Giza 20 cv. showed lower values than those of Giza 6-Mohassen cv. during both of the two growing seasons of this study. Obtained results may be due to that Giza 20 cv. is more adopted to planting in lower Egypt than that of Giza 6-Mohassen which is more suitable for upper Egypt conditions. Such results are in agreement with those of Omran and Awad (1979), Khalil *et al.* (1988b), Koriem and Farag (1990), all working on onion. They reported that different used studied onion cultivars such as Giza 20, Giza 6-Mohassen and Shandweel No. 1 clearly varied in this respect where such cvs. showed higher percentage of doubling than others.

Regarding, the effect of seedling size on percentage of double bulbs, data presented in Table (15) show that significant effect is detected in this respect where the large seedlings (< 16 mm) resulted in higher values than those of either medium or small sized seedlings during both growing seasons of this work. The unfavourable effect of large sized seedling which produced higher percentage of double bulbs was also reported by Strydom (1965), Abu-Zayed (1978), El-Murabaa *et al.* (1979) Koriem and Farag (1990) and Shalaby *et al.*

(1991) working on onion. They indicated also that the onion seedlings of small size produced bulbs of lower percentage of doubling than those of large sized seedlings.

Respecting the effect of interaction between cultivar and seedling size on percentage of split bulbs, the same date presented in Table (15) show that significant differences are obtained during both seasons of this work. It is also evident from such data that each of the small and medium size seedlings of any of the two tested cultivars resulted in significantly lower values than those of the large size seedlings. Generally, it may be stated that growing Giza 20 cv. with small sized seedlings resulted in producing onion bulbs of the lowest doubling percentage. Obtained results herein are in confirmity with those reported by Koriem and Farag (1990) working on onion where they reported that the interaction between cultivars and seedling size was not significant during both seasons of their study.

3.5. Percentage of bolters (premature flowering):

Data showing the percentage of boltering as affected by the two studied factors, *i.e.* cultivar and seedling size as well as their interaction are presented in Table (15). Such data clearly show that the percentage of bolters in onion was significantly affected by cultivar, seedling size and their interaction.

Concerning effect of cultivar on the percentage of bolters, such data show that Giza 6-Mohassen cv. plants resulted in higher values in this regard than those of Giza 20 cv. during both growing seasons. Such varitions between cultivars in this respect were previously reported by many investigators working on onion. Among them were Bhamburkar *et al.* (1986), Koriem and Farag (1990), Jitendra *et al.*

(1992), Warid and Loaiza (1993) El-kafoury *et al.* (1996) Warid *et al.* (1996). However, Omran and Awad (1979) mentioned that no clear differences bewteen grown cultivars were obtained in this regard.

With respect to the effect of seedling size on percent of bolters, the data presented in Table (15) show that percent of bolters was significantly affected by seedling size in both seasons of this study. It is evident that using large seedling (< 16 mm) increased the percent of bolters than either medium or small seedlings in both tested growing seasons. The small used seedlings were of the most favourable effect in this respect showing the lowest values of boltering percentage. Obtained results are in agreement with those of El-Murabaa *et al.* (1979), working on onion where they reported that seedstalk development was accelerated by the increase in size of transplants. Moreover, similar findings were reported by Koriem and Farag (1990) and Shalaby *et al.* (1991), working on onion. They found that growing seedlings of large size increased percentage of bolters compared to those of small size ones.

Regarding effect of interaction between cultivar and seedling size on percent of bolting, data presented in Table (15) show that significant differences are found in this respect during both growing seasons of this study. It is also evident that Giza 20 cv. generally produced bulbs in all studied seedlings sizes with lower percentage of boltering compared with that of Giza 6-Mohassen cv. Obtained results are in harmony with those reported by Koriem and Farag (1990) on onion.

Generally, it may be concluded that using transplants of large size (< 16 mm) of Giza 20 cv. is prefered than those of either small or

medium size transplants of Giza 6-Mohassen cv. Such superiority of this combination between Giza 20 cv. and large sized transplants is due to its higher total and marketable bulb yield (ton/fed.) as well as higher average bulb weight (g). However, the smallest used transplants of Giza 20 cv. resulted in the lowest values of doubling and boltering percentage but in spite of that the marketable bulb yield of the largest used transplants of Giza 20 cv. is still higher than any other combination which makes that such treatment is prefered and advisable than any other one under such conditions.

Table (15): Effect of seedling size of two onion cultivars on bulb yield and its components.

Treatment		Season 1995-1996					Season 1996-1997				
Cultivar	Size (mm)	Total bulbs yield (ton/fed.)	Marketable bulbs yield (ton/fed.)	Average weight of bulb (g)	No. of doubles bulbs (%)	% of No. of bolters bulbs	Total bulbs yield (ton/fed.)	Marketable bulbs yield (ton/fed.)	Average weight of bulb (g)	No. of doubles bulbs (%)	% of No. of bolters bulbs
Giza 20	---	12.568	11.846	127.5	3.27	1.42	12.638	12.336	132.3	0.57	1.41
Giza 6 M.	---	10.997	9.673	114.5	6.52	2.24	10.293	9.984	112.5	1.29	2.09
L.S.D. at 0.05		0.4	0.3	7.5	0.4	1.0	0.9	0.8	6.1	0.3	0.6
---	> 8	8.015	7.922	2.0	0.84	0.01	7.639	7.590	87.6	0.01	0.01
---	8-16	12.969	12.149	129.0	3.40	1.18	12.406	12.273	127.7	0.17	0.82
---	< 16	14.365	12.208	142.1	10.45	4.30	14.351	13.617	151.8	2.61	4.43
L.S.D. at 0.05		0.3	0.3	3.5	0.5	0.7	0.3	0.4	4.0	0.3	0.4
Giza 20	> 8	8.954	8.903	97.1	0.01	0.01	7.931	7.910	89.2	0.01	0.01
	8-16	13.722	13.336	138.9	1.63	0.96	13.911	13.740	142.6	0.33	0.50
	< 16	15.030	13.300	146.6	8.17	3.30	16.071	15.357	165.0	1.36	3.73
Giza 6 M.	> 8	7.076	6.941	86.8	1.67	0.01	7.347	7.270	86.0	0.01	0.01
	8-16	12.215	10.962	119.1	5.17	1.40	10.901	10.807	112.8	0.01	1.13
	< 16	13.700	11.116	137.5	12.73	5.30	12.631	11.877	138.6	3.85	5.13
L.S.D. at 0.05		n.s.	n.s.	4.9	0.6	0.9	0.5	0.5	5.7	0.4	0.6